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CORRELATION OF ESSENTIAL AND TOXIC METALS IN BIOLOGICAL SAMPLES OF ADOLESCENT'S BOYS WORKING IN AUTOMOBILE WORKSHOPS. HEALTH CONSEQUENCES

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Abstract

In developing countries, the presence of toxic metals and the insufficient supply of critical nutrients among adolescent automobile workshop employees is one of the most pressing issues. The current study focused on the health status of 13-17-year-old boys working in automobile workshops in Khairpur, Pakistan. For this study, exchange of some important trace elements: Zinc (Zn) and Iron (Fe), and toxic metals: Cadmium (Cd), and Lead (Pb) in biotic (scalp hair and blood) samples was done. Age matched adolescents from the same localities were chosen as referents. The samples were treated by acid digestion and then analyzed by ICP-OES. All selected workers and referents were examined by the elementary unit/a health care unit, and reports pertaining to the biochemical parameters were obtained. The concentration of Zn and Fe was found to be diminished in all biological samples. Contrarily, a significant concentration of Cd and Pb was recorded in all biological and genetic samples. In all biological samples, a positive correlation (r= 0.653 to 0.78) of Cd and Pb with Fe and Zn was noted. Working boys of the automobile workshops showed a negative correlation between the concentration of Pb and the level of hemoglobin in the biological samples (r= -0.685 to 0.743). It was concluded that the exposure of young boys to toxic metals, due to the lack of safety measures and improper management of the automobile workshops, negatively affects the health of the boys.
However, poor nutritional status may lead to a deficiency in essential elements.
Keywords: Toxic Metals, Zinc (Zn) and Iron (Fe), Cadmium (Cd), and Lead (Pb)

Introduction

There are fewer restrictions on the ages of workers in developing countries because of profit motivation. Younger workers often work in dangerous environments. Many toxicants can be found in these environments (Nouioui et al. 2018). It has been unknowingly reported that many of the toxic metals that are highly persistent and are toxic to humans and the environment might be the result of the many activities conducted by humans (Wu et al. 2016, Rehman et al. 2018, Shah et al. 2020). For Bakulski et al. (2020), the exposure of children to toxic metals is of concern because of the many injuries that are caused by the exposure. These include not just the exposure of the child to the environment but the exposure of the child to the community. Also of concern is the many effects on the exposed child, including the toxic effects. For Zheng et al. (2017), it has also been reported that the exposure of adults to toxic metals has many effects on the adult, including the development of osteoporosis. It has also been reported that metal toxicity affects the metabolism of the adult, causing the adult to develop many complications. It has also been reported that the metal toxicity of the adult is of concern because of the effects on the adult. It has been shown that a disturbed metabolism of metals and the physiological disorders in the adult caused by the metal toxicity of the adult can also be caused by the disturbance.

Zinc (Zn) is a very critical trace mineral because it is essential for the stability of cellular membranes and is critical for many enzymes. Zinc is important for cellular metabolism (Kazi et al. 2008). It is very critical for many major systems of enzymes. It is very possible that the human body has more than 200 major systems of Zndependent enzymes (Classen et al. 2011). These systems of enzymes are important for many cellular functions such as the removal of carbon dioxide from red blood cells, protein synthesis, and many oxidation and reduction processes.

Iron is very crucial for every organism because it is critical for many of the metabolic processes and the functions of enzymes. To minimize the damaging effects of free radicals for RNAs, proteins and membranes, cellular Iron reactivity, availability, and stability is controlled. Iron (Fe) is also important for many of the proteins and enzymes which include various forms of cytochromes, myoglobin, and haemoglobin (Kirby and Danner 2009). It is important for the formation of haemoglobin. Iron deficiency leads to several illnesses, especially in the developing child, which include impairments in mental and physical development, a poor immune system, and low intellectual capacity (Cao et al. 2016).

The chemicals produced by industrial enterprises cause different negative health impacts either to workers or to the community situated around the enterprise. The inhalation of the chemicals by living organismss will likely impact negatively the health of the workers. (Baloch et al.,2020). Workers especially ingest lead and cadmium and other essential elements from various sources (Wasowicz et al. 2001).

Cadmium and lead are other dangerous metals which are important and used in recycling of batteries, paint of vehicles, and other industries which deal with welding, smelting, and mining

(Bertin and Averbeck 2006, Fahad et al. 2020). The general population is exposed to lead by inhalation of the polluted air and dust, and by the contaminated water and food (Tsydenova and Bengtsson 2011). Children are further exposed by lead paint chips and toys (Henn et al., 2011). Cadmium is produced by soldering and is used by metal finishing, batteries, resins and pigments. It is the by product of mining and refining and is released to the air, soil, and water where it accumulates in aquatic biota and in field crops (Ashizawa et al. 2012). The common way of exposure of Humans to cadmium is smoking and eating contaminated food and crops. The highest exposure is from industrial processes from inhalation and unintentional ingestion (Andersen et al. 2004).

Lead (Pb) is one of the most dangerous pollutants and has negative health impacts to almost every body system. Its toxic effects include damages to the kidney, the central nervous system, and hypertensive heart disease and other circulatory diseases.

Both adults and children experience neurotoxicity as the most common form of Pb toxicity (Gil et al. 2011). In developing countries, exposure to work-related Pb for those who repair automobiles and batteries accounts for 0.9% of the total health burden (Alli 2015, Saliu et al. 2015). As automotive industries are being developed globally, the exposure of workshop employees to toxic metals will be multiplied many times over (Pachathundikandi and Varghese 2006). By studying biological samples, the disturbing high levels of toxic metals that workers are exposed to and the drivers of deficient essential trace elements are identified. For workers of all ages, the biological samples that provide the best options with respect to the higher accumulation of toxic metals and the deficiency of essential trace elements are whole blood and hair (Gil et al. 2011, Batool et al. 2015, Li et al. 2015).

Commonly blood offers provisional data, because its cells are renewed every four to six weeks (Gil et al. 2011). Slow growing scalp hair and the absorption of essential metals and toxic heavy metals over a prolonged period may be due to the influential sulfide keratin protein of hair that interacts with metals and metalloids (Molina-Villalba et al. 2015). To assess the imbalance of essential elements and the increased burden of toxic metals, or their symptoms, interactions may disrupt homeostasis and cause numerous pathological conditions.

The lack of essential elements increased the absorption of toxic metals, resulting in the manifestation of their adverse effects on human health, as reported by the studies of Lakshmi Priya and Geetha (2011), Abdulrahman et al. (2012), and Mehra and Thakur (2016). Many small industries/workshop owners, to avoid payment of adult wages, prefer to employ teenage/adolescent boys instead of adult workers (Shah et al. 2010). They disobey the directives and the rules provided by the International Labor Organization, pertaining to the setting of child labor standards for teenage workers in such workshops (ILO Convention 182 on the Prevention and Immediate Action for the Elimination of Child Labor, 1999).

This research focuses on the teenage workers in automobile workshops to examine the health impacts from the exposure to toxic metals and the deficiency of essential trace elements. For the purpose of comparison, the referent subjects were classified into two groups. The exposed referent subjects are those residing near the AMWs, whereas, the non-exposed referent subjects live in an area devoid of any industrial operations. Some of the toxic metals were also analyzed

in the drinking water stored in small tanks at the AMWs and the water supplied to the domestic area by municipal treatment. The soil from AMWs and the domestic area.

Materials And Methods

Chemicals and reagents: The chemicals, and reagents, for the research were of the analytical grade with a high degree of purity. Ultra-pure water from the ELGA water system was used to prepare standards and solutions. (Bucks, UK). To verify the accuracy of the methodology, the matrices were analyzed against the certified reference materials of the environmental SRM 1643e (water) BCR 483 (soil), BCR 397 (Hair), and Clincheck control-human whole blood (Recipe, Munich, Germany). The complete acid digestion process of whole blood serum and hair is done with concentrated nitric acid HNO2 and hydrogen peroxide H2O2.

Instrumentation: For the analysis of trace elements in environmental and biological Sample, the Perkin-Elmer A Analyst 700 Atomic Absorption Spectrometer (Norwalk, CT, USA), Supplied with all the requisite accessories (graphite furnace, auto sampler, background correction system, and sources) was used. The experimental setups and conditions were also described in our earlier works. Shah et al. (2012) discuss the oxidation of biological material substrates with acid mixtures.

Study Population: This research was conducted on 10 younger males employed in the automobile workshops of Khairpur, Sindh, Pakistan. For this study automobile workshops situated in densely populated regions were chosen. Khairpur city has a hot, tropical climate with an average temperature of 30 °C. This leads to high temperatures and a dry climate.

The present study claims that the biological samples (blood and hair) of the untrained 13- to 17-year-old males who had been employed as automobile workshop technicians for the last 1-3 years, were collected during the months of March to May 2021. However, due to the negative attitude of the workshop technicians, only 89 workshop staff were able to provide their biotic samples, in addition to other related information and describe their health issues. As a control group, 88 boys of the same age, who lived in residential areas without any kind of industrial activities, were selected. All the workshop staff performed cleaning, assembly, and manual tasks of disassembling automobile parts, as well as battery maintenance and greasing. The workshop staff also repaired and disassembled the old batteries and separated useful parts such as lead. All the workshop staff belonged to low income families and worked 8 hours a day for 6 days a week.

In many developing countries, insufficient environmental regulations lead to the absence of environmental protection systems in data collection workshops. Eye protection and masks are not provided, nor are rest facilities, a proper environment for medication preparation, and clean drinking water (frequently provided in an open tank). There are also no restrictions on child workers that are enforced by the municipal community, and the state health authorities do not offer any medical assistance following accidental injuries to the children. Research protocols were approved by a conscience/bioethics committee and verbal informed consents were obtained in the local language from all boys and their parents, as most of the boys are illiterate.

A pro forma questionnaire was completed by the boys and a medical officer to obtain demographic information and a health status questionnaire concerning personal hygiene, health complaints, and medication use, as well as assessing their nutritional status and the area of residence.

Sample Collection and Pretreatment : Blood samples (3-5 ml) of both referent boys and working boys were drawn using the EDTA vacutainer tubes (Becton Dickinson (BD), Rutherford, NJ, USA) and mixed thoroughly and stored at −4 ◦C in a transportation tube until analyses were performed. The procedure for blood collection is invasive, and may cause discomfort to the adolescents. A volume of 3.0 mL was drawn from each of the collected blood samples and sent to the pathological laboratories for the analysis of biochemical blood constituents. As for the rest of the subjects that were sampled, their scalp hair was cut using stainless steel scissors which were assembled using Teflon thread.

The biological samples were sealed in polyethylene bags before being sent to the laboratory for storage. Each sample bag was given an identification label which was also attached to the relevant questionnaire. Each hair sample was cut into segments of 0.5 cm and mixed together to form a sample representative of the population targeted in the study. The hair samples were washed to remove any surface contaminants and were prepared for the analysis to determine the concentration of metal ions in the samples. A washing procedure was conducted in which hair samples were washed in dilute Triton X-100 followed by rinsing in acetone and distilled water. The samples were dried in an oven set at 80°C.

Acid Digestion : For the blood and hair samples, metal analysis was conducted using three samples taken from the same population. A mixture of nitric acid and an oxidizing agent (hydrogen peroxide) in the ratio of 2:1 was added to the samples. After the initiation of the oxidation reaction at room temperature was maintained for 10 to 15 minutes, the samples were placed in a domestic Pel microwave for 2 to 4 minutes at 80% of the total power (900W). After the oxidation of the biological samples, the contents of the flasks were cooled and 10 ml of 0.2 M HNO3 was added to each flask. The solution was filtered and set aside for analysis. The atomic absorption spectrophotometer (Perkin Elmer, AAS-PEA-700) was used to evaluate the presence of the essential metals (Zn, Fe) and the toxic metals (Pd, Cd) in the prepared sample solutions. The spectrophotometer was operated in a flame and graphite furnace mode. **Sampling :** The soil and water samples (10 composite samples each) were collected from 10 auto workshops. The samples of treated soil and water from the city were collected from non-industrial areas (n= 100 each). The physicochemical parameters (pH, salinity, conductivity) were measured. The Pb and Cd were examined in soil and water samples from the workshops and factory. We recently provided a method for the enrichment of treated municipal water by cloud point extraction (Bilal et al., 2016). In both workshops, soil samples were collected in the workshop from 6 to 10 random spots, depending on the layout of the workshop. To assess the different types of workshops, composite soil samples were prepared in the lab. For the selected subjects from non-industrial areas, soil samples were collected from the garden areas of their houses. In separate attempts done in triplicate, composite soil samples were treated with a mixture of H2SO4, HNO3, and H2O2 (1:1:1) and heated to the 90-100 °C for 1 to 2

hours. After cooling, 10 mL of ultra-pure water was added, and then the sample was filtered. This was done to prepare reference soil solutions from different areas.

Soil And Water and Samples Of Automobile Garages : Khairpur's municipally treated water supplies have a pH range of 7.2 - 7. Water samples collected from containers in automobile workshops (AMWs) without covers had an average Cadmium (Cd) concentration of 6.1–6.5. Detections of Cadmium (Cd) and lead (Pb) in consumption water obtained from municipally treated aquatic supply systems ranged with respect to 3.0 to 5.6 μgL^{-1} and 11.2 to 17 μgL^{-1}, which are somewhat higher than the WHO permitted limits (10 and 3.0 µgL−1), correspondingly (Table 4). As a result, Cd and Pb levels in the water containers of automobile workshops were between 15.5 - 19.7 and 35 - 48 μgL^{-1}, which were five to six and three to fivefold higher than WHO drinking water guidelines (WHO, 1996). It is acknowledged that drinking water obtained from the vessels of the shops is one of the main sources of toxic metal exposure to workers and especially teenagers. Long-term low-level exposure to Cd and Pb has been shown in the literature to induce harm to the liver, kidneys, blood, and bone tissues (Sommar et al. 2013). Lead (Pb) intake was reported to be 1.5-2.4 and 1.2-1.8 g/kg body weight per day, in Adolescents respectively, equivalent to 42.9 to 67.3 % and 34.6 to 51.3 % of the PMTDI for Pb in adolescents weighing 35 kg.

Table 1: Cadmium (Cd) and Lead (Pb) contents in water and soils of non-exposed and automobile workshops (AMW).

Sampling	Cd	Pb
Water (µg L^{-1})		
Municipal-treated water	4.6 ± 0.82	13.7 ± 1.76
Automobile workshops (AMW).	17.2 ± 1.38	41.5 ± 4.23
Soil (mg kg^{-1})		
Non-exposed areas	15.5 ± 3.04	35.7 ± 3.95
Automobile workshops (AMW).	64.4 ± 6.1	234.8 ± 7.1

It is practical to conclude that the pH of soil which collected from workshops and non-industrial areas is between 5.8 and 6.6 and 7.4 and 76, separately. The lesser pH of soil sample extracted from AMW strength to attributed to acid leakage occurring when preparing, charging, and washing automobile vehicles. There was a range of Cd and Pb in the surface samples bring and collected from different AMW, varying from 53.1-70 and 225-240 mg kg−1, respectively. We found that Cd and Pb concentrations in soil samples of native areas were 12,2-17.5, 58.6-70 mg kg^{-1}, which was three to four times subordinate than those standards initiate in soil samples of factories and workshops areas. The results confirm those reported formerly (Carrizales et al. 2006). Although Pb levels were higher in workshop's soil sample, these standards values were still more than two-fold lower than the maximum allowed limit of Pb (400 mg/kg) in soils. In contrast, research found that the average Pb content in soils around the world ranges from 10-67 mg kg^{-1}, with a mean of 32 mg kg^{-1}.

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Statistical Analysis

Excel X State (Microsoft Corp., Redmond, WA) and Minitab 13.2 (Minitab Inc, State College, PA) were used for arithmetical analysis. The significance of the reported differences in metal concentrations in worker and control biological samples was assessed.

Results

Clinical and hematological Parameters of automobile workshops (AWB) and referent boys (RB) are given in Table 1, While the mean values of Zinc in scalp hair samples along with median values are shown in Table 2. The values of Zn in in scalp hair samples of AWB was significantly lower at 95% % confidence interval [CI] with median, lower and higher values as 160.0 [155.0, 166.5) than referent boys 204.5 [197.5, 212.5] µg/g). It was observed that 18.3% zinc was lower in AMW than referent boys.

Table 2 Validation of metals determination by microwave assisted digestion of CRM of biological samples

CRM of BCR 397 (hair) (µgg^{-1})				
Element	**Certified values**	**Obtained values [c]**	**T $_{value}$ [a]**	**% Recovery [b]**
Zinc	199±5	197±10.0 (4.98) [d]	0.371	98.9
Iron	580.0±10 [e]	570±20.8 (3.59) [d]	0.649	98.2
Cadmium	0.52±0.024	0.509±0.022 (4.39) [d]	0.219	97.8
Lead	33±1.2	32.4±1.18 (3.48) [d]	0.283	98.1
Clinchek®, human (whole blood) (µgL^{-1})				
Zinc[f]	2.27±0.06	2.23±0.059 (2.61) [d]	0.224	98.2
Iron[f]	14.2±3.24	14.0±3.18 (4.58) [d]	0.251	98.5
Cadmium	1.2±0.4	1.18±0.095 (7.49) [d]	0. 123	98.3
Lead	105±24	103±7.2 (6.88)[d]	0.124	98.0

Keywords.

[a] Paired t-test between certified values versus found values, degree of freedom (n-1) =5

[b] %Recovery = (Obtained value/Certified valve) ×100.

[c] Mean±standard deviation.

[d] Values in parenthesis (%RSD)

[e] Indicative value

[f] Indicated in milligram per litre

Table 3 Analytical results of certified reference materials of cadmium (Cd) and Lead (Pb) in water and soil

	Water SRM 1643e	Soil amended with sewage sludge BCR 483	Hair BCR 397	Clincheck control-human whole blood (Recipe, Munich, Germany)
Cadmium				
Cerified values	6.568 ± 0.073c	24.3 ± 1.3	0.072 ± 0.010	1.21 ± 0.07
Experimental Value	6.48 ± 0.24 (3.63)	23.87 ± 2.17 (9.05)	0.071 ± 0.0013 (1.66)	1.189 ± 0.11 (9.16)
T value[a]	0.8617	0.794	0.07148	0.852
% recovery[b]	98.6	98.2	98.6	98.2
Lead				
Certified values	19.63 ± 0.21	229.0 ± 8.0	3.83 ± 0.18	104.8 ± 7.3
Experimental Value	19.34 ± 0.075 (0.382)	225.3 ± 19.4 (8.52)	3.76 ± 0.22 (5.78)	103.4 ± 4.78 (4.58)
T value[a]	0.620	0.851	0.7429	0.8078
% recovery[b]	98.5	98.3	98.1	98.6

Table 4 Essential and toxic elemental concentration of Zinc, Iron, Lead and Cadmium in biological samples of referents and Automobile workers (Adolescents). Scalp hair adolescents 13-17 years Automobile Workshops (AMW).

Scalp hair		
Elements	Referents	AMW
Zn (µg/g)	205 ± 10.5	160 ± 15.3
Fe (µg/g)	23.9 ± 3.63	14.2 ± 1.25
Cd (µg/g)	0.53 ± 0.09	2.15 ± 0.35
Pb (µg/g)	1.65 ± 0.35	3.91 ± 0.51
Blood		
Zn (mg/L)	6.52 ± 0.55	4.25 ± 0.40
Fe (mg/L)	430 ± 15.9	353 ± 19.7
Cd (µg/L)	1.52 ± 0.30	4.82 ± 0.45
Pb (µg/L)	92.5 ± 2.60	316 ± 9.52

The contents of Fe in in scalp hair samples of AWB was significantly lower at 95% % confidence interval [CI] with median , lower and higher values as 14[12.5, 16.0] than referent boys 23.8[21.1, 26.85] µg/g). It was observed that 41.1% iron was lower in AMW than referent boys**.** The obtained values of cadmium in scalp hair samples of AWB was pointedly higher at 95% with median and confidence interval [CI], lower and higher values as 2.15 [1.99, 2.33] than referent boys 0.53 [0.42, 0.64] (µg/g) resulted values are 75.3% cadmium was higher in AMW than referent boys

The contents of lead in hair samples of AWB was pointedly higher at 95% with median and confidence interval [CI], lower and higher values as 3.9 [3.61, 4.23] than referent boys

1.6[1.52, 1.68] (µg/g) and results showed that the concentration of lead was 59% higher in AMW than referent boys

Blood : The concentration of zinc in blood samples of AWB was pointedly lower at 95% with median and confidence interval [CI], lower and higher values as 4.17 [4.02, 4.59] than referent boys 6.57[6.40, 6.75] (mg/L) and results showed that the concentration of Zn was 59% lower in AMW than referent boys

The concentration of iron in blood samples of AWB was pointedly lower at 95% with median and confidence interval [CI], lower and higher values as 354.5[346, 362] than referent boys 429.5[421, 442] (mg/L) and results showed that the concentration of Fe was 17.46% lower in AMW than referent boys.

The concentration of cadmium in blood samples of AWB was significantly higher at 95% with median and confidence interval [CI], lower and higher values as 4.79[4.69, 4.95] than referent boys 1.53[1.44, 1.64] (µg/L) and results showed that the concentration of Cd was about three folds higher in AMW than referent boys ($p< 0.001$).

The concentration of lead in blood samples of AWB was significantly higher at 95% with median and confidence interval [CI], lower and higher values as 316[308, 324] than referent boys 92.2[89.0, 95.3] (µg/L) and results showed that the concentration of Cd was 70% higher that is about three folds higher in AMW than referent boys.

Biochemical parameters: The biochemical parameters of all selected participants were received from basic health care unit pathology laboratories. Young workers' biological reports disclose reduced hemoglobin (Hb), red blood cell numbers, and hematocrit levels which are shown in (Table 5).

Table 5 Clinical and biochemical parameters of referents automobile workers with normal range

Parameter	Referent	Automobile Workers	Normal Range
Haemoglobin (g/dL)	13.2 ± 1.6	9.5 ± 1.05	14.1 – 17.2
Haematocrit (%)	48.8 ± 3.2	37.2 ± 4.1	40 – 50
Serum ferritin (µg/L)	34.4 ± 2.3	23.8 ± 3.3	< 35
Red blood count (RBC) ($\times 10^6$/mm^3)	5.0 ± 1.4	3.4 ± 1.09	4.1 – 6.2
WBC ($\times 10^3$/mm^3)	7.9 ± 2.8	6.1 ± 2.1	4.8 – 11.7
Platelets ($\times 10^3$/mm^3)	204 ± 26.5	167.8 ± 13.2	150 – 500
BMI (kg/m^2)	18.2 ± 1.2	16.7 ± 1.5	21.7 – 26.8
ESR (mm/1 h)	11.2 – 15.6	26.3 – 28.7	0 – 25
Urinary N-acetyl-β-glucosaminidase (NAG) (IU/L)	4.7 ± 1.1	11.5 ± 2.09	-

Vehicle workshop employees claim anemic symptoms appear in 80% of adolescents, with hemoglobin levels being between 8% and 10%. This is likely the result of a combination of a poor diet and the toxic environment present in the workshops and garages. A previous study cites the direct association of high Pb exposure with anemic conditions in adolescents (Shah et al. 2010).

Lead Pb exposure is known to damage blood functions. It reduces the production of red blood cells and the blood component, heme, (Conterato et al. 2013). It was reported that the concentration of Pb in both biological samples of working boys in automobile workshops was inversely correlated with the level of hemoglobin. It was documented that the automobile

workshop (AMW) and factory workers experienced stomach problems and poor eyesight. Most of these adolescent workers also suffer from poor hygiene, improper waste disposal, a lack of personal protective equipment (PPE), and poor due diligence, which increases their exposure to toxic substances.

AMW workers making complaints of kidney disorders and showing significantly lower than required ($p< 0.05$) levels of creatinine in urine sample tests. N-acetyl-beta-glycosaminidases (NAG) of AMW workers showed higher than normal levels and may result in kidney disorders and may further lead to nephrosis (Panhwan et al 2016). It is important to note that the erythrocyte sedimentation rate (ESR) of AMW employees under the age of 18 exceeds normal levels and signifies variability in the presence of many clinical disorders.

Discussion and Conclusion

Discussion

In developing countries like this one, the combination of poverty and low literacy levels among the majority of the youth (male) population means that, instead of going to school, many young boys go to work in factories and workshops. Since most of these boys come from underprivileged families lacking many of the essentials. Boys working in car workshops are given various tasks like cleaning or washing cars, scraping paint off cars, and servicing and maintaining car batteries. The workers' biochemical parameters show that they are all in the range of having anemia with hemoglobin levels from 8.5 to 10% which is significantly lower than boys of the same age group and having the same degree of anemia. The anemia is attributed to poor nutrition, and the toxic and unfair working environment, which also contribute to the poor health of the workers, are from the workshops. It has been reported that young car workers complain of a number of health issues such as stomach problems and skin irritations which could be caused by the toxic working environment combined with a total lack of health safety protection. Young car workers spend many hours of toxic working environment. There is a total lack of health safety protection. Young car workers spend many hours of toxic working environment. There is a total lack of health safety protection. Young car workers spend many hours of toxic working environment. Young car workers spend many hours of toxic working environment.

In the last three decades the effects of low public nutrition on the poor health of the population have been given significant a great deal of attention. The most frequent worldwide public health nutritional problem is the deficiency of Fe. According to a recent WHO report, Fe deficiency (anemia) occurs in 600–700 million persons globally. Around half of these are children in developing countries (Sherriff et al. 2001). Current dietary Fe consumption is inadequate. The principal cause of Fe deficiency in developing countries is a cereal-based diet. Phytates, oxalates and phosphates in cereal based diets increases fiber content and decreases Fe absorption. Generally, Fe deficiency is attributed to the presence of phytates in a diet. The presence of even small amounts of phytates has a significant impact (Horton and Ross 2003).

Fe intake is also inadequate in infants and children. This causes anemia and other disorders. Therefore, Fe supplements should be used to fill this dietary gap (Halterman et al. 2001). Because the working children live in unsanitary conditions, in addition to nutritional deficits,

gastrointestinal diseases may also be causes of anemia. The deficiency of Fe causes generally weakness delays in the psychomotor and physical development of children and adolescents (Grantham-McGregor and Ani 2001). In developing countries, the dietary restrictions in adult populations lead to the deficiency of meat, fish (which are a rich source of essential micronutrients) and other foods, resulting in a deficit of Zn. This is combined with existing problems of Fe deficiency, especially in developing countries (Soylak et al. 2007).

Phytate-rich foods can impede zinc absorption. Phytate-rich foods can reduce zinc absorption. Social factors are known to affect the concentration of zinc in children's blood and their hair samples. The lowest levels of zinc in blood and hair were found in children from families with low incomes and in children who neglected to eat meat (Brown et al., 2001). Compared to adults, children and adolescents are at a greater disadvantage from the harmful exposure to the non-essential toxic metals cadmium (Cd) and lead (Pb). Children's greater disadvantage to these metals is from low tolerance to Pb and Cd. The disadvantage is from a high consumption of food, air, and liquids relative to body weight as well as the anatomy and physiology of a child's brain. In addition, children may have greater absorption Pb because in some cases it is easier for children to absorb Pb (Soylak et al., 2005). Children who have low meat sources of iron (Fe) and calcium (Ca) have a higher absorption of lead (Pb). Thus, the low absorption of these metals is due to the poor socioeconomic conditions of a developing country and therefore a deficiency in Fe also causes a greater concentration of Cd and Pb (Naseri et al., 2021). Cadmium (Cd) interferes with the routes and the procedures of Fe absorption on the surfaces of mucosal cells and the Fe release on the contra-luminal side. It has been known for a long time that Cd possessions can be lowered when there is adequate intake of Zn and Fe (Nouioui et al., 2018). Fe and Cd concentrations in employees of automobile workshops have been reported to be high because the employees spent most of their time at the workshops. Cadmium is known to interfere with Fe metabolism.

In rats, the divalent metal transporter was shown to possess the ability to bind both Cd and Fe, presenting an opportunity to define a competitive situation for an essential and a toxic metal. Consequently, Cd was shown to be accumulated in rats in the absence of Fe. Cd accumulation in the liver of rats was also documented. The experimental results demonstrated that the lower the concentration of Fe was, the greater was the concentration of the toxic metal Cd. Through the experiment of perfused mouse duodenum, a reduction of Fe due to Cd was also shown. It is also likely that the occupation of the vacant spaces, which should be equilibrated with Fe, resulted in greater retention of Pb in the organism, and thus is likely to be the reason for greater retention of lead with a lower rate of its elimination. The findings reported so far demonstrate that the shortage of iron in children clears the way for the lead increase in the biological samples of toxic agents.

The results of the study indicate lower concentrations of essential trace elements (Fe, Zn) in both whole blood and scalp hair in adolescents of automobile workshops (AMW) when compared to controls, while hazardous elements Pb and Cd were higher in both whole blood and scalp hair of adolescents.

It has been seen that low nutrition children have a deficiency in essential trace elements. This has led to an increase in toxic trace metals in children, possibly caused by the replacement of vital divalent ions by lead. Due to the consumption of low-quality food and contaminated water, the lead concentration in children is elevated. Blood is the main transport medium of lead, which passes into different body organs and tissues and is retained in the body for prolonged periods. Normal and essential trace metals move across the blood-brain barrier and other membrane barriers, and through gut, and intestinal walls, where active transport occurs. Some specific transport mechanisms exist for these metals in the body, which include some specialized and specific transporters. Toxic trace metals also use these transport mechanisms and move across these barriers, especially when the levels of essential trace metals in food and in the diet are very low. This will serve to increase the toxic metal trace elements, especially within the intestines (Bressler et al., 2007). To assess lead concentrations in biological samples, the best matrix among blood, serum, and plasma is whole blood. This might be attributed to the greater affinity of lead to Red Blood Cells, compared to Lead's affinity to serum, and plasma.

It easily passes to the central nervous system and the placenta which is more dangerous to the developing fetus of a pregnant woman. Research has shown through cross-sectional and epidemiological studies that children with blood Pb levels of around 100 mg/L or even lower had poor social and mental development among children (Ahamed et al. 2007). Generally, children have Pb levels due to their oral habit. Pb in the environment increases their levels and there is no evidence of sex differences in blood lead levels among the children (Lidsky and Schneider 2003). Our study and different studies of the different parts of the world show that one of the risk factors of children is the level of lead and the education of mothers (Wang et al. 2002). Uneducated mothers are the main reason for the increase in lead levels in children. They do not know the different hazardous sources of lead in the environment and the major effects of lead on health. About 72.5% of mothers are uneducated and therefore there are no preventive measures at the individual level. The vulnerability to Lead (Pb) intoxication also increases because of the high number of children and poor nutrition in the family. Pb substitutes Ca in the bones and causes lead poisoning.

In addition, the findings indicate that long-term consumption of drinking water containing Cadmium (Cd) leads to the replacement of Zinc (Zn) and causes swelling and stiffening of blood vessels (Mathee et al, 2002).

Conclusion

There are disturbed biochemical parameters and a lack of fundamental elements in the body, such as Zinc and Iron. This is coupled with increased concentrations of toxic metals Cadmium and Lead that were found in the biological samples (hair and blood) of the adolescent workers from various automobile workshops. The findings of the disturbed biochemical parameters suggest that most workers are anemic because of the absorption of Cadmium and Lead, which also disturbed the biochemical parameters of Hemoglobin. Unsanitary conditions of cleaning, washing, scraping, and repairing batteries are the reasons why 50% of the workers have confirmed kidney disorders with increased levels of serum creatinine, N-acetyl-beta-

glucosaminidase (NAG), and decreased creatinine clearance. From the combined effects of a polluted environment and drinking water with a metal concentration above the WHO permissible limits, harmful elements are presented that indicate a negative impact on the health of children. With poor hygiene such as a frequent contaminated food supply, or chewing of smokeless tobacco, a decrease in the absorption of essential elements also promotes the absorption of toxic metals to accelerate.

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